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Specification and Drawings, as originally filed, with Application for Patent Serial No: 2,190,233, on November 13, 1996, by D. LEE MANNER, for "Combustion Fuel Source".

PRIORITY DOCUMENT

Agent certificateur/Certifying Officer

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Ottawa Hull K1A 0C9

(21) (A1) 2,190,233
(22) 1996/11/13
(43) 1998/05/13

(51) Int.Cl.[6] C10L 5/40; F24B 13/00

(19)(CA) **APPLICATION FOR CANADIAN PATENT** (12)

(54) Combustion Fuel Source

(72) Manner, D. Lee - Canada ;

(71) Same as inventor

(57) 17 Claims

ABSTRACT

A combustion fuel source includes a body comprising a porous carrier and a solid fuel. When combustion is established, solid fuel is vaporized and moves through the porous carrier to one or more surfaces of the body wherein it is combusted. A portion of the heat resulting from this combustion maintains the vaporization of the solid fuel for continued combustion. A variety of materials can be used as the porous carrier, including combustible materials such as paper fibres, cloth, powered coal or charcoal and non-combustible materials such as ground pumice, sand or ceramic materials. A variety of solid fuels can be used, including paraffin wax, beeswax and waxes or wax-like materials derived from animal and/or vegetable processing. The body can be shaped into preselected shapes according to an intended use and/or can be placed into non-combustible structures to provide stoves or other heating devices.

Combustion Fuel Source

FIELD OF THE INVENTION

The present invention relates to a combustion fuel source. More specifically, the present invention relates to a novel combustion fuel source which is relatively clean burning, safe and environmentally friendly.

BACKGROUND OF THE INVENTION

Combustion fuel sources abound and include a wide range of sources, from the common, such as fire wood, to the high tech such as the solid fuel rockets. While many combustion fuel sources exist, it is desired to have a substantially clean burning fuel source which is inexpensive, safe, convenient to use and which uses readily available materials.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a novel combustion fuel source which obviates or mitigates at least one of the disadvantages of the prior art.

According to a first aspect of the present invention, there is provided a combustion fuel source comprising:

a porous carrier including at least one surface for a combustion site; and

a solid fuel impregnated into said porous carrier such that, when ignited at said at least one surface by an ignition means, said solid fuel is combusted and heat from said combustion vaporizes additional solid fuel in said porous carrier which travels through porous carrier to said at least one surface wherein it is combusted.

Preferably, said porous carrier is cellulose. More preferably, said porous carrier is dried paper pulp. Also preferably, the porous carrier is formed into a preselected shape. Preferably, said preselected shape is conical.

Also preferably, said fuel source further comprises a combustion initiating means. Preferably, said combustion initiating means comprises a wick which is ignited to initiate combustion of said fuel source. Also preferably, said fuel source further comprises an ignition means adjacent said combustion initiating means such that ignition of said ignition means ignites said combustion initiating means which, in turn, ignites said solid fuel.

According to another aspect of the present invention, there is provided a stove comprising:

a shell having a substantially open surface and ventilation means to introduce air to a combustion site within said stove;

a fuel source within said shell and including a porous carrier whose upper surface acts as a combustion surface and a solid fuel impregnated into said porous carrier such that, when ignited at said at combustion surface said solid fuel is combusted and heat from this combustion vaporizes additional solid fuel within said porous carrier which travels through said porous carrier to said combustion surface wherein it is combusted.

Preferably, in one embodiment said porous carrier comprises cellulose fibres. More preferably, the cellulose fibres comprise dried paper pulp. In another embodiment, said porous carrier comprises non-combustible materials. More preferably, the porous carrier comprises sand, ground pumice or the like.

BRIEF DESCRIPTION OF THE DRAWINGS

Preferred embodiments of the present invention will now be described, by way of example only, with reference to the attached Figures, wherein:

Figure 1 shows a combustion fuel source in accordance with an embodiment of the present invention;

Figure 2 shows a combustion fuel source in accordance with another embodiment of the present invention;

Figure 3 shows a section taken through line 3-3 of Figure 2;

Figure 4 shows a partially cut away combustion fuel source in a stove in accordance with another embodiment of the present invention;

Figure 5 shows a combustion fuel source in accordance with another embodiment of the present invention for use in wood or coal furnaces and the like; and

Figure 6 shows an improved match which includes a fuel source in accordance with the present invention.

DETAILED DESCRIPTION OF THE INVENTION

In Figure 1 a combustion fuel source in accordance with the present invention is indicated generally at 20. Fuel source 20 includes a body 24 formed of a porous carrier and a solid fuel. As used herein, the term 'porous' is intended to comprise any carrier structure which is substantially porous to vapours of the vaporized solid fuel permitting vapours from solid fuel which is vaporized with body 24 to move to the exterior of body 24.

As shown in the Figure, in a present embodiment, body 24 is shaped in the general form of a truncated cone and includes, at the apex of the cone, a combustion initiating means, such as wick 28, and an ignition means, such as a safety match 32 which is partially embedded into body 24 adjacent wick 28.

It should be noted that wick 28 is only provided to ease the initiation of combustion of fuel source 20 and wick 28 need not be provided in circumstances wherein other means of initiating combustion of fuel source 20 are available. In fact, when provided, wick 28 is generally quite short in length and will only burn for a relatively short period of time. Similarly, safety match 32 is only provided as a convenience and safety match 32 need not be provided in circumstances wherein other means of igniting fuel source 20 are available.

It should also be noted that fuel source 20 is not limited to a body of generally conical shape and other shapes may be employed as desired. As will be

described below, combustion of fuel source 20 involves a surface effect and thus different shapes provide different combustion characteristics. For example, a generally conical shape has a large surface area and provides relatively large amounts of heat, but burns correspondingly quicker than shapes with relatively smaller exposed surface areas which provide relatively less heat but burn longer.

In one embodiment, the porous carrier of body 24 comprises cellulose fibres. Specifically, body 24 comprises paper pulp which has been formed into the desired shape and dried. It has been found that the selection of the paper pulp influences the combustion properties of fuel source 20. In particular, it is presently believed that paper pulp of relatively course fibres results in a fast and hot combustion relative to that obtained from fuel source 20 when paper pulp of relatively finer fibres (apparently resulting in a denser, less vapour permeable porous carrier) is employed. Other suitable porous materials include cloth, ground coal or charcoal.

It has also been determined that the porous carrier need not be combustible. Specifically, other porous materials such as ground pumice, sand, granular ceramic materials, etc. and other materials have been employed with favourable results.

While not completely understood, it is presently believed that two factors generally influence the performance of the porous carrier in fuel sources in accordance with the present invention. These two factors are (i) the ability of vaporized solid fuel to move through the porous carrier; and (ii) the ability of the porous carrier to transfer heat from the combustion surfaces into body 24 to vaporize the solid fuel. In addition, selection of the porous carrier will affect the ash remaining after the fuel source has combusted. For example, use of a combustible material as a porous carrier will result in little waste materials (ash) while use of non-combustible materials will result in more waste material. It is believed that the selection of suitable porous carriers for various application will be apparent to those of skill in the art.

The solid fuel of body 24 is preferably a wax, such as paraffin wax or beeswax, although other waxes and wax-like substances such as animal or vegetable shortening may also be employed, if desired. In combustion, portions of the solid fuel are first liquefied and then vaporized for combustion. As will be apparent, the porous carrier serves to hold liquefied wax and to allow the vaporized wax to move through the carrier to the combustion site.

While waxes or the like are presently preferred for convenience, cost and environmental considerations, it is presently believed that the only required criteria for the solid fuel is that it can be vaporized by the heat present within body 24 when fuel source 20 is being combusted and that its vapours can move through the porous carrier to the combustion site.

The manufacture of fuel source 20 of Figure 1 has been performed in the following manner. A carrier is formed from paper which is soaked in water and coarsely macerated to obtain paper pulp which is then pressed into a generally conical shape and dried. The dried, formed carrier is then emersed into paraffin wax or beeswax which has been heated to liquefy it. The carrier absorbs the liquefied wax until it is saturated and then the carrier is removed from the liquefied wax and set aside to allow the wax to solidify to obtain body 24.

When solidified, a small bore can be formed in top of body 24 and wick 28 inserted into the bore and bonded in place with a drop of liquid wax. It should be noted that, as mentioned above, wick 28 is optional and when provided is only employed to initiate combustion of fuel source 20. Thus, wick 28 need not penetrate body 24 to any great extent and a penetration of a half inch or less has been found to be satisfactory. When wick 28 has been placed, another small bore can be formed into the top of body 24, adjacent wick 28, to receive safety match 32. As also mentioned above, safety match 32 is also optional and need not be included. It will also be apparent to those of skill in the art that the present invention is not limited to the use of safety matches and that these are

merely preferred for safety reasons and that other ignition devices can be employed if desired.

Ignition of fuel source 20 is easily accomplished by igniting wick 44, if present, or otherwise heating a portion of body 24 and igniting the resulting vaporized solid fuel. When first lit, combustion occurs only in the area adjacent the point of ignition. However, as the solid fuel adjacent the combustion area is warmed and then vaporized, combustion spreads to substantially the entire exposed surface of body 24 (i.e. - all of the surface except the base which is effectively smothered by the support surface on which it rests). It should be noted that combustion of fuel source 20 is apparently a surface effect and it has been noted in tests that solid fuel which has been liquefied but not vaporized and which has leeched out of body 24 and onto the support surface does not tend to ignite.

Fuel source 20 has been tested in various configurations. Specifically, in one test the relatively course paper employed in egg crates and the like has been employed as the porous carrier and this has resulted in a relatively hot and quick combustion of fuel source 20. In another test, finer paper, such as that employed in newsprint, has been employed as the porous carrier and this has resulted in a relatively less hot, but longer burning combustion of fuel source 20. In both cases, it should be noted that the combustion of fuel source 20 appeared to be particularly efficient, with little, if any, soot being produced.

As best understood, in the present invention the porous carrier apparently transports the solid fuel which has been vaporized from within body 24 to the surface of body 24 wherein combustion is occurring. It is presently believed that the relative coarseness of the porous carrier regulates the speed with which this transport occurs and thus is one of the limiting factors in the combustion process. It is also believed that the porous carrier also serves to assist heat transfer from the combustion surface into body 24 to promote vaporization of the solid fuel and also allows air to be drawn into body 24 below the combustion surface to facilitate clean and complete combustion.

As mentioned above, it is not necessary that the porous carrier be itself combustible. For example, in another test fuel source 20 has been manufactured with crushed pumice as the porous carrier. In this embodiment, the crushed pumice is placed into an inverted conical form and liquefied wax is poured into the form. When the wax has set, wick 28 and safety match 32 can be inserted if desired, as before.

In tests, this embodiment of fuel source 20 was found to burn particularly hot and relatively quickly and it is believed that this is due to the relatively large amount of heat transferred into body 24 by the pumice from the combustion surface, thus promoting the rapid vaporization of the solid fuel. It is contemplated that finer control of the combustion characteristics will be possible by crushing the pumice, or the like, to different particle sizes.

Another property of fuel source 20 is that the porous carrier substantially retains its shape and cohesiveness throughout substantially the entire combustion period of fuel source 20. This is believed to be due to the vaporized solid fuel which moves through the porous carrier to the combustion surface, the vapours apparently serving to assist the porous carrier in retaining its structure until the solid fuel is exhausted. This simplifies clean up and disposal of spent fuel source 20.

The embodiment of the present invention shown in Figure 1 is presently preferred for use as a fire starter by hikers, campers and the like and it is believed will start a campfire of even wet wood. However, it will apparent to those of skill in the art that a variety of other embodiments can also be produced. For example, as discussed below with reference to Figures 2 and 3, the present invention can be used in candles and the like.

Figure 2 shows another embodiment of the present invention which is useful as a candle, torch or the like. Fuel source 40 is generally cylindrical and, in a similar fashion to fuel source 20 described above, can include an initiation means, such as wick

44, and an ignition means, such as safety match 48. As shown in Figure 3, Fuel source 40 includes a cylindrical body 52 which comprises a porous carrier and a solid fuel and also preferably includes an outer sheath 56 formed of a less porous carrier and/or a denser solid fuel. Sheath 56 has been found to encourage the combustion of fuel source 40 at the upper end of the cylinder and to inhibit the spread of combustion of fuel source 40 from the upper end to the side walls of the cylinder by providing a relatively impermeable barrier to vaporized solid fuel.

In one embodiment of fuel source 40, body 52 is formed in the same manner as that described above for fuel source 20, with the pulp of relatively coarse paper fibres being formed into a cylindrical shape, rather than a conical shape, and liquid wax being subsequently impregnated into the dried carrier and allowed to solidify. Sheath 56 is then formed from paper, such as newsprint, which is rolled relatively tightly about body 52 and then dipped briefly into liquid wax. When the wax of sheath 52 has solidified, a bore is formed in the upper end of fuel source 40 and wick 44 can be inserted and/or a bore is formed in the upper end of fuel source 40 and a safety match 48 can be inserted.

In tests, body 52 has been formed of relatively coarse paper fibres from paper egg crates and impregnated with beeswax and sheath 52 has been formed of rolled newsprint which is then impregnated with paraffin wax. This combination has been found to provide a relatively hot flame which is well contained by the paraffin wax in sheath 56. Other combinations have also been successfully tried, including body 52 being formed from rolled newsprint and impregnated with beeswax or paraffin wax and sheath 52 constructed as before.

It should be noted that, as was the case with fuel source 20, wick 44 is only provided, if at all, to simplify the initiation of combustion of fuel source 40. Thus it is not required that wick 44 extend along body 52 to any extent beyond that desired to achieve the desired initiation of combustion and a wick of a half inch or less will generally be sufficient. However, if it is desired to enhance the ease with which fuel source 40 may be

re-lit, wick 44 can extend along the majority of body 52 and can be used to re-light fuel source 40.

In a similar fashion, safety match 48 is not required and is only provided if desired. If safety match 48 is not provided, any suitable ignition means may be employed, as will occur to those of skill in the art.

Also, as mentioned above, the cohesiveness of the porous carrier in fuel source 40 is augmented by the solid fuel vapours which move through the porous carrier and thus fuel source 40 typically does not drop ash or other waste while combustion is occurring.

Figure 4 shows another embodiment of the present invention wherein a stove 100 employs a fuel source in accordance with the present invention. Stove 100 comprises an outer shell 104 which, in a presently preferred embodiment of the invention, is an aluminium or steel food or beverage can which has been recycled. As shown in the Figure, the top has been removed from shell 104 and a series of ventilation holes 108 have been placed around the upper edge of shell 104. A fuel source 112 in accordance with the present invention is placed within shell 104 and a bore is formed in the upper surface of fuel source 112 and a wick 116 inserted therein.

As with other embodiments of the present invention, fuel source 112 comprises a porous carrier and a solid fuel. Several varieties of porous carrier have been successfully tested to date, including the above-mentioned relatively coarse paper fibres from paper egg crates which have been soaked and macerated into a pulp which is shaped, pressed and dried. This carrier was then emersed in liquefied paraffin wax until it is impregnated with wax. Stove 100 with such a fuel source 112 has been found to provide sufficient heat to boil a pot of water resting on the upper edge of stove 100 in a reasonably quick manner. It has also been determined that, once the combustion process is fully established in fuel source 112, stove 100 is substantially wind proof and is difficult to

extinguish by any means other than smothering stove 100.

Another embodiment which was tested for use with stove 100 was a porous carrier formed from tightly rolled corrugated cardboard which was placed in the stove with the channels formed by the corrugations of the cardboard being oriented vertically. Liquefied paraffin wax was then poured into the stove 100 until the porous core would not accept more wax. This embodiment of stove 100 has been found to provide a hot and relatively large flame, the combustion process apparently being augmented by vaporized wax which travels relatively quickly and easily along the above-mentioned channels. As with the other embodiments of stove 100, this embodiment can be difficult to extinguish other than by smothering and is substantially wind proof.

Other embodiments of fuel source 112 have also been tested with favourable results, including fuel sources with porous carriers of rolled newsprint, crushed pumice, etc. and solid fuel of beeswax and/or animal and vegetable waxes.

As with the other embodiments of the present invention, wick 116 is not required and other suitable means of initiating combustion can be employed as will occur to those of skill in the art.

In another embodiment of the present invention, shown in Figure 5, fuel source 200 is configured into a slab, log or brick-like configuration for use in a wood or coal-fired stove or furnace. Fuel source 200 comprises a porous carrier and a solid fuel, as before. Representative examples of suitable porous carriers include paper fibres formed and dried as described above, wrapped cloth, powered coal and/or non-combustible materials such as crushed or ground pumice, sand or the like. The solid fuel used in fuel source 200 can comprise paraffin wax, beeswax, or animal or vegetable derived waxes, shortenings or the like.

It is contemplated that in such general heating applications, it may be

desirable to limit the area of the combustion surface to reduce the combustion rate. In such cases, fuel source 200 can first be placed in a shield, such as a metal pan (not shown), which closely matches the outside dimensions of fuel source 200 and which serves to limit combustion to the upper surface of fuel source 200 and to inhibit combustion from occurring on the sides. As will be apparent to those of skill in the art, inhibiting flames from the sides only requires the shield to be in close proximity, for example one half inch, to the sides of fuel source 200 and does not require contact with the sides of fuel source 200.

In a test, a fifteen inch by twelve inch by four inch fuel source 200 comprising a porous carrier formed from tightly wound bristle board (fine cardboard) impregnated with paraffin wax and placed in a shield, as described above, was combusted in a wood burning furnace. Fuel source 200 was found to burn in the furnace for approximately twenty-four hours and to provide the equivalent amount of heat as a medium sized wood fire. In this test, the combustion of the wax appeared to be sufficiently complete that no substantial amount of harmful chimney deposits were detected.

It is also contemplated that, fuel source 200 is formed of a non-combustible porous carrier, such as pumice, the solid fuel may be replenished as desired. For example, if a slab or brick like carrier is employed, additional solid fuel can be liquefied and introduced to the lower surface of the porous carrier. Alternatively, solid fuel can be introduced adjacent to the porous carrier and liquefied by waste heat from the combustion. In either case, this liquefied solid fuel is drawn into the porous carrier under osmosis-like action and is heated therein, vaporized and combusted. It is contemplated that this introduction of additional solid fuel can be accomplished on an ongoing basis, if desired, by any suitable means as would occur to those of skill in the art. Alternatively, the porous carrier can be recovered, when fuel source 200 is spent, and re-impregnated with solid fuel as desired.

Figure 6 shows another embodiment of the present invention wherein an

improved match 300 includes a fuel source 304 in accordance with the present invention. In this embodiment, fuel source 304 comprises a porous carrier and solid fuel, as before, which has been bonded to a carrier stick 308. Carrier stick 308 can be formed of combustible materials such a wood or paper like a conventional match, or can be formed of incombustible materials such as metal of glass if desired. A conventional match-type ignition composition 312 is located at the tip of fuel source 304 such that, when appropriately struck, composition 312 ignites and initiating combustion of fuel source 304. It is contemplated that, in some circumstances, it may be desirable to include a wick (not shown) extending from fuel source 304 into composition 312 to assist in the initiation of combustion in fuel source 304. As match 300 combusts fuel source 304, rather than carrier stick 308 as in a conventional match, it is contemplated that match 300 will provide a longer burn time and/or a greater heat supply and, like other embodiments of the present invention, this embodiment can be difficult to extinguish other than by smothering and is substantially wind proof.

Further, match 300 is presently believed to be an effective method of initiating combustion in fuel sources in accordance with the present invention wherein a wick is not provided. The substantial heat developed by match 300 and its relatively long burn time are advantageous for this purpose.

The above-described embodiments of the invention are intended to be examples of the present invention and alterations and modifications may be effected thereto, by those of skill in the art, without departing from the scope of the invention which is defined solely by the claims appended hereto.

We claim:

1. A combustion fuel source comprising:

a porous carrier including at least one surface for a combustion site; and

a solid fuel impregnated into said porous carrier such that, when ignited at said at least one surface by an ignition means, said solid fuel is combusted and heat from said combustion vaporizes additional solid fuel in said porous carrier which travels through porous carrier to said at least one surface wherein it is combusted.

2. A fuel source according to claim 1 wherein said porous carrier comprises cellulose fibres.

3. A fuel source according to claim 2 wherein said cellulose fibres are dried paper pulp.

4. A fuel source according to claim 1 wherein said porous carrier is formed into a preselected shape.

5. A fuel source according to claim 4 wherein said preselected shape is substantially conical.

6. A fuel source according to claim 1 wherein said fuel source further comprises a combustion initiating means adjacent said at least one surface.

7. A fuel source according to claim 6 wherein said combustion initiating means comprises a wick which is ignited to initiate combustion of said solid fuel.

8. A fuel source according to claim 6 wherein said fuel source further comprises an ignition means adjacent said combustion initiating means such that ignition of said ignition means ignites said combustion initiating means which, in turn, initiates combustion of said solid fuel.

9. A fuel source according to claim 1 wherein said porous carrier comprises granular material.

10. A fuel source according to claim 9 wherein said granular material is selected from the groups comprising crushed pumice, sand and powdered coal.

11. A fuel source according to claim 1 wherein said porous materials comprises cloth fibres.

12. A fuel source according to claim 1 wherein said solid fuel is selected from the group comprising paraffin wax, beeswax, wax derived from animal products and wax derived from vegetable products.

13. A fuel source according to claim 5 wherein said preselected shape is a cylinder and said fuel source further comprises an outer sheath which is denser, relative to said porous carrier and said outer sheath is impregnated with a solid fuel.

14. A stove comprising:

a shell having a substantially open surface and ventilation means to introduce air to a combustion site within said stove;

a fuel source within said shell and including a porous carrier whose upper surface acts as a combustion surface and a solid fuel impregnated into said porous carrier such that, when ignited at said at combustion surface said solid fuel is combusted and heat from this combustion vaporizes additional solid fuel within said porous carrier which travels through said porous carrier to said combustion surface wherein it is combusted.

15. A stove according to claim 14 wherein said porous carrier comprises cellulose fibres.

16. A stove according to claim 15 wherein said cellulose fibres comprise dried paper pulp.

17. A stove according to claim 14 wherein said solid fuel is selected from the group comprising paraffin wax, beeswax, wax derived from animal products and wax derived from vegetable products.

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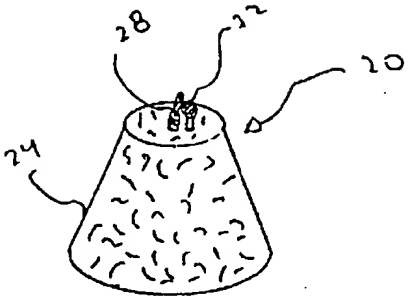

FIGURE 1

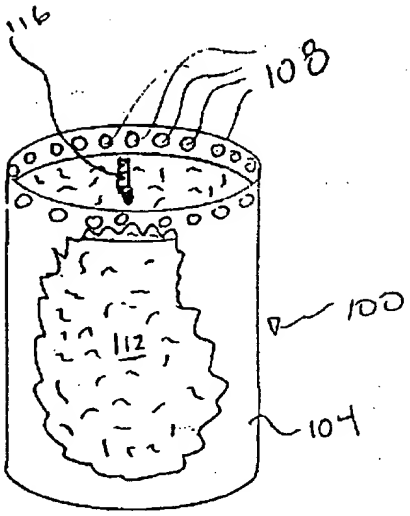

FIGURE 4

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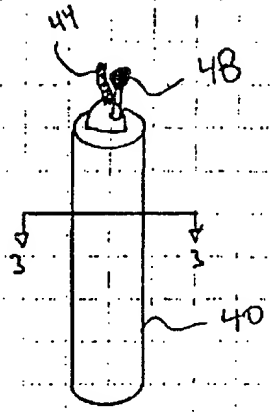

FIGURE 2

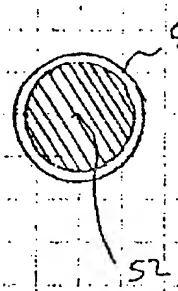

FIGURE 3

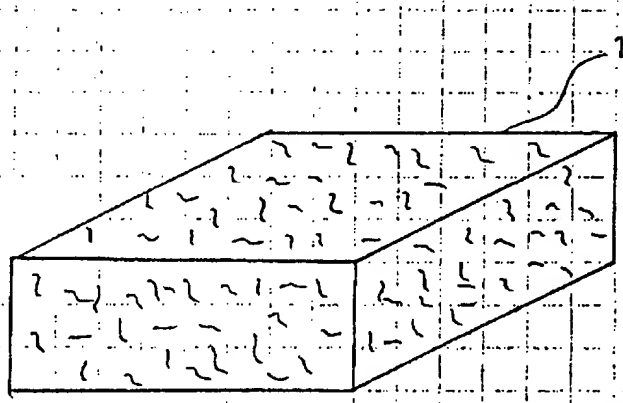

FIGURE 5

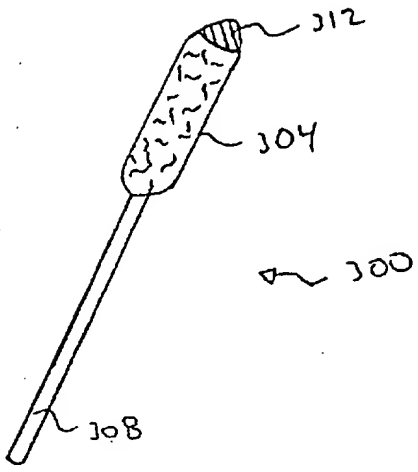

FIGURE 6